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Research Note

The Occurrence of *Otodistomum plunketi* Fyfe, 1953 (Digenea: Azygiidae), in Rays (Chondrichthyes: Rajidae) Around the Falkland Islands

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ABSTRACT: The occurrence of a large digenean, *Otodistomum plunketi,* in 8 rajid host species from the Falkland Islands was investigated. All infected hosts are new host records for *O. plunketi.* The parasites were in the abdominal cavity except in 1 individual host, which harbored some trematodes within the pericardium. The prevalence and mean intensity of *O. plunketi* in all hosts examined were 31% and 1.95, respectively. *Bathyraja multispinis* had the greatest infection rate, with a prevalence of 100%, a mean intensity of 50.4, and a range of 8–136 parasites. *Bathyraja scaphiops* and *Raja doellojuradoi* were not infected. For *Bathyraja albomaculata,* a significant positive correlation ($P < 0.05$) was found between mean abundance and total length. For the remaining hosts, no relationship was found between intrinsic host factors and infection. Thirty small crabs, *Peltarion spinosulum,* a major prey item for *B. multispinis* and *B. albomaculata,* were examined for *O. plunketi* metacercariae but were not infected.

KEY WORDS: *Otodistomum plunketi,* Digenea, Azygiidae, rays, Chrondrichthys, Rajidae, Falkland Islands.

A directed fishery for rajids has operated in Falkland Islands waters since 1990, with large catches being taken in the first 3 yr of the fishery. More than 15 species of rajids occur in the Falkland Islands Interim Management and Conservation Zone and the Falkland Islands Outer Conservation Zone. The taxonomy of several of these rajid species is under review (Pompert, unpublished data).

Otodistomum plunketi Fyfe, 1953, a large digenean trematode, was originally described from the Plunket dogfish *Centroscymnus plunketi* (Waite, 1909) off New Zealand by Fyfe (1953) and was reported from ''*Raja longirostris*'' (probably erroneously) off the Pacific coast of the former U.S.S.R. by Skrjabin and Guschanskaja (1954) and from the Portuguese dogfish *Centroscymnus coelolepis* Bocage and Capello, 1864, in the northwest Atlantic by Harshbarger and Gibson (1982). Dawes (1946, 1947) and Brinkmann (1975) considered that all the species of the genus *Otodistomum* of which they were aware were members of the same variable species, *Otodistomum veliporum* (Creplin, 1837) Stafford, 1904. However, Gibson and Bray (1977) believed that *O. plunketi* could be distinguished from other species in the genus, except for *Otodistomum pristiophori* (Johnston, 1902) and *Otodistomum hydrolagi* Schell, 1972, by its location in the host and by the broad shape of its body. *Otodistomum pristiophori* was recorded from the longnose sawshark *Pristiophorus cirratus* (Latham, 1794) in Australian waters by Johnston (1902) and Woolcock (1935) and from the smallnose fanskate *Psammobatis microps* Günther, 1880 (this is a junior synonym of *Sympterygia bonapartii* Müller and Henle 1841), and the Argentine angelshark *Squatina argentina* (Marini, 1930), in the Atlantic Ocean off northern Argentina by Ostrowski de Núñez (1971). *Otodistomum hydrolagi* was recorded from the spotted ratfish *Hydrolagus colliei* (Lay and Bennett, 1839) off the Pacific coast of the U.S.A. by Schell (1972). *Otodistomum plunketi* differs from the other 2 remarkably similar species in its larger size, wider extracecal region of the body, longer uterine field and more posterior position of the gonads, and the absence of a union of the excretory arms in the forebody (Gibson and Bray, 1977). The specimens examined in this study agree with the characterization of *O. plunketi* given by Gibson and Bray (1977).

During a research cruise on the R/V *Dorada* from 17 to 29 June 1999, 273 rajids of 8 species were sampled during routine biological work. A random subsample of 239 rajids was examined for *O. plunketi* (Table 1). The rajids' total length, disk width (both to the nearest centimeter be-

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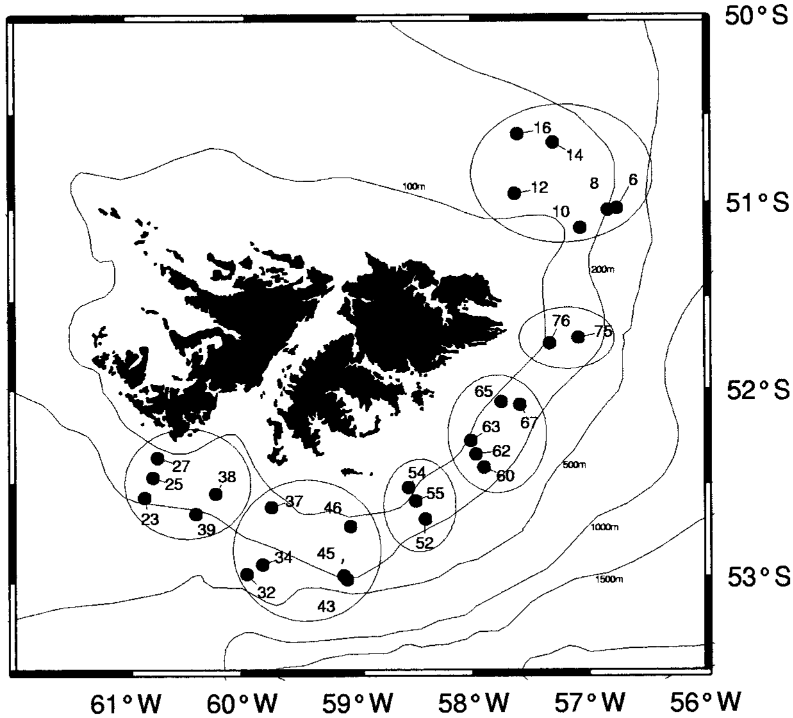

Figure 1. Stations sampled for rays and *Otodistomum plunketi* on R/V *Dorada* (ZDLH1).

low), and weight were recorded. They were also sexed and graded to a Falkland Islands Fisheries Department (FIFD) maturity scale. The abdominal and the pericardial cavities of each skate were opened, and the organs were examined for *O. plunketi*. Representative samples were collected and stored in both 99% ethanol and 10% buffered formol-saline for the FIFD reference collection.

The concepts denoted by the terms prevalence, mean intensity, and mean abundance of infection are as defined by Bush et al. (1997). To eliminate possible geographical effects, the relationship between intrinsic host factors and *O. plunketi* infection was investigated with pooled data from 6 arbitrarily defined areas (see Fig. 1) and was examined only for those hosts with sample sizes of greater than 30 individuals. Because the parasites showed an overdispersed frequency distribution in their hosts (high variance-to-mean ratio), mean abundance was transformed as $\log(n + 1)$ to reduce variance (which helped normalize the data) (Elliot, 1971) and was compared with the intrinsic host factors of total length and disk width with the use of the Spearman's rank correlation coefficient (r), simple linear regression, and analysis of variance (ANOVA). Prevalences were compared geographically, in the 6 arbitrary areas, as proportions by the χ^2 test, and abundances were compared by the Kruskal-Wallis test.

All infected host species, with the exception of 1 specimen examined, harbored *O. plunketi* only within their abdominal cavities. The excepted specimen was a female multispine skate *Bathyraja multispinis* (Norman, 1937), and 4 of 136 *O. plunketi* were recovered from the pericardium. Many of the hosts examined showed small scars that were produced by the ventral and oral suckers of *O. plunketi* on the surface of the organs within the abdominal cavity and were most conspicuous on the liver.

The prevalence and mean intensity of *O. plunketi* in all hosts examined were 31% and 1.95, respectively. Of the host species examined, *B. multispinis* had the highest prevalence (100%), a mean intensity of 50.4, and a range of 8–136 parasites. The cuphead skate *Bathyraja scaphiops* (Norman, 1937) and Doello-Jurado's

Table 1. Prevalence, mean intensity, and mean abundance of *Otodistomum plunketi* infecting rays in the Falkland Islands.

Host species	No. sampled	Prevalence (%)	Mean intensity (±SD)	Range	Mean abundance
Bathyraja multispinis	5	100.00	50.41 (±50.28)	8–136	50.40
Bathyraja albomaculata	58	58.62	5.50 (±2.33)	1–12	1.46
Bathyraja sp.	15	33.33	2.40 (±1.67)	1–5	0.80
Bathyraja brachyurops	49	20.41	2.60 (±0.84)	1–4	0.53
Bathyraja macloviana (Norman, 1937)*	4	25.00	2.00	—	0.50
Bathyraja griseocauda	89	21.35	1.58 (±1.22)	1–6	0.22
Bathyraja scaphiops	15	0.00	0.00	—	0.00
Raja doellojuradoi	4	0.00	0.00	—	0.00

* Falkland skate.

skate *Raja doellojuradoi* Pozzi, 1935, were not infected (Table 1).

Only 3 host species, the white-spotted skate *Bathyraja albomaculata* (Norman, 1937), the broad-nose skate *Bathyraja brachyurops* (Fowler, 1910), and the gray tail skate *Bathyraja griseocauda* (Norman, 1937), of the 8 examined were investigated for relationships between infection and intrinsic host factors because the sample sizes of the remaining hosts were considered too small. *Bathyraja albomaculata* showed a significant positive correlation between mean abundance and total length ($r = 0.755$, $P < 0.05$), suggesting that the parasites accumulate with host length/age. Further investigation showed no relationship between host length and mean abundance for the remaining 2 host species and no relationship between prevalence and mean abundance for host sex, host capture depth, and host capture location.

The 5 sampled *B. multispinis* had fed exclusively on a small crab, *Peltarion spinosulum* White, 1843, 30 of which were examined for *O. plunketi* metacercariae but were uninfected. Previous diet studies (Brickle and Pompert, unpublished data, 1994–2000) showed that *B. multispinis* feeds almost exclusively on *P. spinosulum*, which was also found in the diet of *B. albomaculata*. Sample sizes of *P. spinosulum* were probably too small to recover infections because of the contagious nature of parasite frequency distributions within their host populations.

All of the infected hosts examined in this study are new host records for *O. plunketi*. This work is part of an ongoing project within the FIFD.

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Research Note

Belostomatidae (Insecta: Heteroptera) as Intermediate Hosts of Digenetic Trematodes

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ABSTRACT: Three species of *Belostoma* Latreille, 1807 (Insecta, Heteroptera) were found to be intermediate hosts of digenetic trematodes of the genus *Stomylotrema* Looss, 1900, parasitic in birds. Several infected specimens of *Belostoma elegans* (Mayr, 1871) and *Belostoma oxyurum* (Dufour, 1863) were collected in the Arroyo Zapata, Province of Buenos Aires, Argentina; one infected specimen of *Belostoma foveolatum* (Mayr, 1863) was found in the Arroyo Cuña-Pirú, in the Province of Misiones. Encysted metacercariae were found mainly in the abdominal cavity of adult male and female belostomatids, with low prevalences and variable intensities of infection. Species of *Belostoma* are reported for the first time as intermediate hosts of digenetic trematodes and as new intermediate hosts for representatives of the genus *Stomylotrema.* Natural infections of adult *Stomylotrema* spp. were found in several insectivorous birds present in the Buenos Aires study area. The role of other aquatic organisms as intermediate hosts of *Stomylotrema* spp. is discussed.

KEY WORDS: *Belostoma,* Insecta, intermediate hosts, trematodes, metacercariae, *Stomylotrema,* Argentina.

Members of the Belostomatidae (Heteroptera), broadly known as ‘‘waterbugs,’’ are common aquatic insects found in water bodies on nearly all continents, although they show their greatest diversity in South America. At least 29 species of this family have been reported from Argentina (Schnack, 1976), 17 of them belonging to the American genus *Belostoma* Latreille, 1807.

Reports on endoparasitism or commensalism in species of *Belostoma* are scarce. There are 1 record of Mermithidae (Nematoda) from *Belostoma elegans* (Mayr, 1871) (see De Villalobos et al., 1998) and 1 of Temnocephala (Platyhelminthes) (see Moretto, 1978) from *Belostoma cummingsi* De Carlo, 1935, both from Argentina. However, species of this genus were hitherto unknown as intermediate hosts of vertebrate parasites.

As a part of an extensive study on aquatic insects as potential intermediate hosts of bird parasites in the Province of Buenos Aires, Argentina, specimens of waterbugs from the Arroyo Zapata, near Punta Blanca (34°56′S; 57°41′W) were examined for helminths in spring–summer (September to February) of 1999 and 2000. During the study, large encysted metacercariae were found and collected from the body cavities of adult *B. elegans* and *Belostoma oxyurum* (Dufour, 1863). These metacercariae are identified and described herein.

The insects were captured every 2 mo with hand nets, always from the same section of the stream, and were maintained in aquaria until examined. Encysted metacercariae recovered from the hosts were studied and measured in vivo under a stereoscopic microscope. Some cysts were opened mechanically with the aid of needles, and the excysted metacercariae were observed in vivo in saline under coverslide pressure. Some of them were fixed in 10% formalin or Bouin’s solution, stained with carmine hydrochloride, and mounted in Canada balsam. Live cysts and excysted metacercariae were photographed with a WILD MPS 46/52 Photoautomat®, and drawings of stained metacercariae were made with a drawing tube. Measurements of Bouin's-fixed specimens are given in millimeters as the range followed by the mean in parentheses. Voucher specimens are deposited in the Helminthological Collection of La Plata Museum (CHMLP), La Plata, Argentina, Nos. 4812 to 4825.

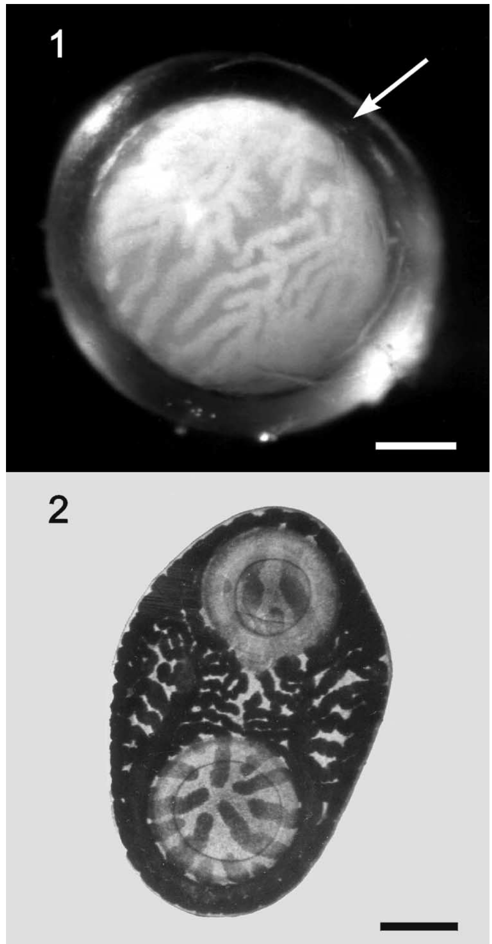
In addition to these findings, live encysted metacercariae similar to those found in *B. elegans* and *B. oxyurum* were recovered in October 2000 from the body cavity of an adult *Belostoma foveolatum* (Mayr, 1863) captured in a light trap in the Arroyo Cuña-Pirú (27°05′15″S; 54°57′09″W), Province of Misiones, Argentina. These metacercariae were studied by the same procedures indicated above and were also deposited in the CHMLP with accession number 4826.

The cysts were recovered mainly from the abdominal cavity of the insects, but a few were found in the thoracic muscles. Both males and females were infected. The prevalence was relatively low: 13.88% in *B. elegans* (n = 72) and 3.40% in *B. oxyurum* (n = 176), and the intensities of infection ranged from 1 to 14 (mean = 4.4) metacercariae per host in *B. elegans* and from 1 to 4 (mean = 2.1) in *B. oxyurum*. The single specimen of *B. foveolatum* from Misiones harbored 9 cysts.

The metacercariae were identified as belonging to the genus *Stomylotrema* Looss, 1900, whose final hosts are birds. They were easily recognized, even prior to excystation, because of the characteristic shape of the excretory vesicle, which is highly ramified and readily visible through the cyst wall. The cysts were large, rounded, and whitish when alive. They were 0.85–1.25 (1.02) in diameter and had a thick wall of 0.040–0.180 (0.090), which was flexible and transparent (Fig. 1).

Live excysted metacercariae (Fig. 2) were about 1.36–2.25 (1.85) long by 0.80–1.53 (1.12) wide and moved actively. Their most striking feature was the distinct excretory vesicle, filled with an opaque substance. The vesicle was U-shaped, with numerous lateral secondary branches and a terminal excretory pore.

Mounted metacercariae (Fig. 3) measured 1.25–2.00 (1.59) long and 0.655–0.879 (1.11) wide, the oral sucker 0.365–0.586 (0.447) by 0.394–0.662 (0.507) and the pharynx 0.086–0.173 (0.132) by 0.106–0.192 (0.155). The esophagus was highly variable, from apparently absent to 0.121–0.304 long. The ventral sucker was 0.461–0.643 (0.539) by 0.432–0.691 (0.572). The primordial ovary, testes, and cirrus sac were always present. The ovary measured 0.097–0.145 (0.117) by 0.072–0.126 (0.104), the right testis 0.106–0.169 (0.137) by 0.097–0.164 (0.129), the left testis 0.126–0.179 (0.160) by 0.121–0.188 (0.152), and the cirrus sac 0.362–0.550 (0.433) long by 0.048–0.097 (0.066) wide. Primordia of the seminal vesicle, cirrus, and Mehlis' glands were always observed. Laurer's canal was easily seen in live specimens. Pri-



Figures 1, 2. 1. Live encysted metacercaria from the abdominal cavity of *Belostoma elegans*. Arrow indicates cyst wall. Scale bar = 0.2 mm. 2. Live excysted metacercaria, ventral view, showing the appearance of the excretory vesicle. Scale bar = 0.2 mm.

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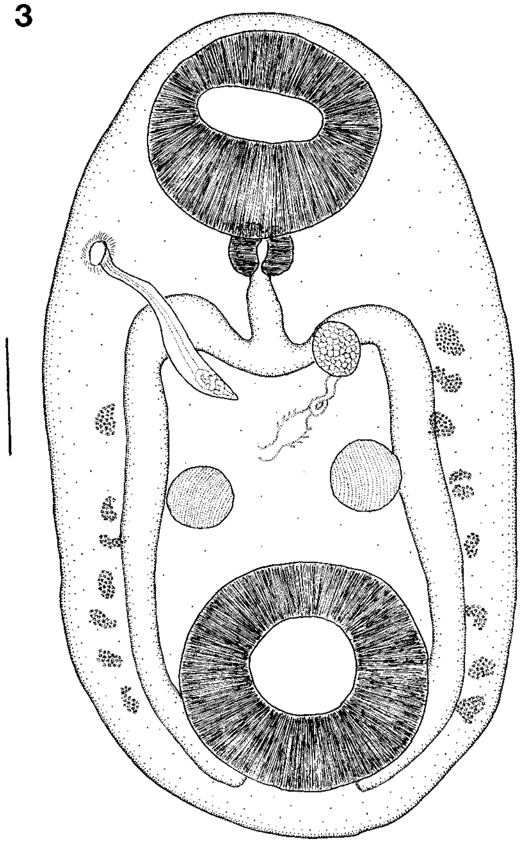

Figure 3. Excysted metacercaria, ventral view. Excretory vesicle omitted. Scale bar = 0.5 mm.

mordial vitelline follicles were usually present, arranged 7 poral and 9 antiporal, with different degrees of development.

Previous reports of metacercariae of the Stomylotrematidae are relatively scarce. Shyamasundari and Rao (1998), in a comparative study of the helminths of 2 species of Ardeidae from India, mentioned, without more details, the insect *Abedus ovatus* Stål, 1862 (Belostomatidae), as the intermediate host for *Stomylotrema vicarium* Braun, 1902, a parasite of the cattle egret *Bubulcus ibis coromandus* (Boddaert, 1783) and the Indian pond heron *Ardeola grayii* (Sykes, 1832). With respect to this reference, it is worth noting that species of *Abedus* Stål, 1862, have a North American distribution, and it is impossible to know whether the mention by Shyamasundari and Rao (1998) resulted from a misidentification of the insect by the authors or referred to a nonnative insect species. Metacercariae of *Stomylotrema* sp. were also recorded in adults of the Nepidae (Heteroptera) from India (Dhanumkumari and Madhavi, 1983) and in the body cavity of larval Dytiscidae (Coleoptera) from Argentina (Ostrowski de Núñez, 1978). Ostrowski de Núñez (1978) successfully infected chickens and a lapwing, *Vanellus chilensis* (Molina, 1782), with naturally encysted metacercariae and obtained mature adults that were identified as *S. vicarium*. Cysts of *Laterotrema* (Semenow, 1927), the other genus in the family, were found in nymphs of Anisoptera (Corduliidae, Libellulidae, and Aeschnidae) from Tatar, Azerbaijan (Lyubarskaya and Galeeva, 1980).

The present finds of cysts in representatives of 3 species of *Belostoma* constitute new host records for species of *Stomylotrema.* These finds also confirm the role of aquatic insects as second intermediate hosts in the life cycle of these trematodes.

Waterbugs are known to be a part of the diet of at least 2 bird species in the Buenos Aires study area, the white-faced ibis *Plegadis chihi* (Vieillot, 1817) and the yellow-winged blackbird *Agelaius thilius petersii* Laubmann, 1934 (A. Cicchino, Museo de la Plata, personal communication), both of which were found to be definitive hosts of *Stomylotrema* spp. (Digiani, 1999). Thus, waterbugs are probably normal hosts for these parasites, in spite of the low prevalence observed.

Other bird species in the area studied are also recorded as definitive hosts of *Stomylotrema* spp., including species of Ciconiiformes, Charadriiformes, Gruiformes, Cuculiformes, and Passeriformes (Digiani, 1999). Although some of these birds could not be confirmed to prey on waterbugs, it is likely that other species of aquatic insects in the area also serve as intermediate hosts for these parasites.

The role of other aquatic organisms as intermediate hosts of *Stomylotrema* spp. remains to be confirmed. There are a few reports of excysted metacercariae of *Stomylotrema* spp. from freshwater fishes. Singh and Prasad (1978) found 1 specimen in the intestine of *Mystus striatus* (*nomen dubium,* probably a member of the Bagridae) from India. In Argentina, 1 excysted specimen showing the same characteristics as those now found in insects was recovered from the intestine of the silver catfish *Rhamdia sapo* (Valenciennes, 1840) from the Province of Misiones (unpublished data, specimen deposited in the CHMLP No. 4827). Because both were finds of single, excysted, and immature specimens from the intestine of the hosts, these records seem to represent cases of accidental parasitism, probably due to ingestion of infected insects by the fish.

Specific identification of the parasites is not possible at the metacercarial stage and was not considered to be within the scope of this contribution. Even when feeding experiments are conducted in order to arrive at the adult stages, reliable characters for differentiating species of *Stomylotrema* are still controversial (Digiani, 1999; Macko et al., 1999), and detailed studies of adults from both natural and experimental infections are needed for this little-known group.

I am indebted to Julián F. Petrulevicius for determining *B. foveolatum,* his invaluable assistance in the field and permanent support during daily work. Ana Lía Estévez and Pablo Pérez-Goodwyn determined the other species of *Belostoma.* Thanks are also due to Mariana Demaría, Sebastián Calvo, and María Eugenia Alzugaray for collecting the insect and fish from Misiones. John M. Kinsella kindly provided essential bibliography and Margarita Ostrowski de Núñez critically reviewed the manuscript. The valuable comments and suggestions of 2 anonymous reviewers are also acknowledged. This study was conducted while the author had a postdoctoral fellowship from the Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina.

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Research Note

Blood Parasites of American Crows (*Corvus brachyrhynchos*) and Fish Crows (*Corvus ossifragus*) in Florida, U.S.A.

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ABSTRACT: Blood films from 46 fish crows (*Corvus ossifragus* Wilson) and 42 American crows (*Corvus brachyrhynchos* Brehm) from Florida, U.S.A., were examined for blood parasites. *Haemoproteus picae* Coatney and Roudabush, *Haemoproteus danilewskii* Kruse, *Trypanosoma avium* (Danilewsky), and microfilariae of an unidentified filarioid were identified from both species of crows. An unidentified species of *Hae-*

moproteus and *Trypanosoma ontarioensis* Woo and Bartlett were observed in American crow blood films. Fish crow blood films contained *Plasmodium relictum* Celli and Sanfelice. Prior to this study, *T. avium* and *P. relictum* had not been reported from fish crows.

KEY WORDS: fish crow, *Corvus ossifragus,* American crow, *Corvus brachyrhynchos, Haemoproteus, Trypanosoma, Plasmodium,* microfilariae, Florida, U.S.A.

Fish crows (*Corvus ossifragus* Wilson, 1812) and American crows (*Corvus brachyrhynchos* Brehm, 1822) are fairly common year-round residents of the state of Florida, U.S.A. (Robertson and Woolfenden, 1992; Stevenson and Anderson, 1994). Whereas American crows are found throughout most of North America, fish crows have a much more restricted range, primarily the southeastern U.S.A. (Stevenson and Anderson, 1994). Over their entire ranges, 19 species of blood parasites have been reported from American crows, whereas fish crows have had only 3 parasite species reported (Greiner, Bennett, Laird, and Herman, 1975; Bennett et al., 1982; Bishop and Bennett, 1992). Published information from Florida is limited to reports of *Haemoproteus picae* Coatney and Roudabush, 1937, and *Haemoproteus danilewskii* Kruse, 1890, from 4 fish crow blood films deposited at the International Reference Centre for Avian Haematozoa, Queensland Museum, Brisbane, Australia (Bishop and Bennett, 1990, 1992). The objective of the present study was to increase the available knowledge of the blood parasite fauna in American crows and fish crows in Florida.

Fish crows were captured during November and December 1999 at Micanopy, Alachua County, Florida (29°30′N; 82°17′W), with modified Australian crow traps baited with live birds (Johnson, 1994). The crows were removed from the traps daily and held for up to 5 days in a flight cage until a sufficient number of birds had been captured for sampling. Each bird was bled via jugular venipuncture, and thin blood films were prepared immediately. American crows were killed and collected during October and November 1975 at Fisheating Creek, Glades County, Florida (26°57′N; 81°19′W) by shooting them as they flew into an evening roost. Fish crows were captured as a part of a serosurvey of crows for West Nile virus and American crows were collected for a study of *Dispharynx nasuta* (Rudolphi, 1819). All necessary collection and animal care and use permits were obtained for these studies, and no additional blood was drawn to facilitate this study. Blood films were prepared immediately from clean blood collected at the site of injury or the brachial vein. Films were fixed with absolute methanol, stained with Giemsa, and examined with a compound microscope at magnifications of ×400 and ×1,000 for a minimum of 40 min, approximately 20 min at each power. Identification of protozoan parasites was made at ×1,000. All blood films from American crows have been deposited in the International Reference Centre for Avian Haematozoa at the Queensland Museum (Accession Nos. 110377 through 110414). Voucher specimens from fish crows have been deposited at the U.S. National Parasite Collection in Beltsville, Maryland, U.S.A. (Accession Nos. 91232 through 91239).

Table 1. Prevalence of blood parasites observed in fish crows and American crows from Florida, U.S.A.

	No. crows infected (%)	
Parasite	Fish crow (n = 46)	American crow (n = 42)
Haemoproteus picae	8 (17%)	7 (17%)
Haemoproteus danilewskii	1 (2%)	2 (5%)
Haemoproteus sp.	0	1 (2%)
Plasmodium relictum	6 (13%)	0
Trypanosoma avium	10 (22%)	3 (7%)
Trypanosoma ontarioensis	0	1 (2%)
Trypanosoma sp.	0	1 (2%)
Unidentified microfilariae	2 (4%)	8 (19%)

We found 6 species of blood parasites in the 88 crows sampled (Table 1). Parasites were observed in 19 (45%) American crows; 15 exhibited a single species of parasite, and 4 were infected with 2 species of parasites. American crows were infected most commonly with unidentified microfilariae and *H. picae.* Of the 4 American crows infected by 2 species of parasites, 2 birds had both *H. picae* and unidentified microfilariae, 1 bird had *Trypanosoma ontarioensis* Woo and Bartlett, 1982, and *H. picae,* and 1 bird had *Trypanosoma* sp. and unidentified microfilariae. Parasites were observed in 23 (50%) fish crows; 19 had 1 species of parasite, and 4 were infected by 2 species of parasites. Fish crows were most commonly infected with

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Trypanosoma avium (Danilewsky, 1885) and *H. picae*. Of the 4 fish crows infected with 2 species of parasites, each was infected with *T. avium*, but the second parasite was different for each bird, either *H. danilewskii, H. picae, Plasmodium relictum* Celli and Sanfelice, 1891, or unidentified microfilariae.

Haemoproteus picae and *H. danilewskii* were observed in both the fish crows and the American crows sampled in this study. These were the only 2 haemoproteid species that Bishop and Bennett (1990) redescribed from members of the family Corvidae. We found a similar occurrence of both parasites in both host species. Our findings are consistent with those of Greiner, Bennett, Laird, and Herman (1975), who compiled haemoparasite data for 580 American crows from throughout North America. In this compilation, a single study (Scarvie and Clark, 1971) accounted for 46% of the infections of *Haemoproteus* reported. Scarvie and Clark (1971) identified haemoproteid parasites in 86% ($n = 63$) of American crows examined from Washington state, U.S.A. In Newfoundland, Andrews and Threlfall (1975) found infections with *Haemoproteus* in only 6% ($n = 99$) of American crows sampled. Greiner, Bennett, Laird, and Herman (1975) reported results from only 7 fish crow blood films, from which no *Haemoproteus* were observed.

In Florida, few other haemoparasite surveys of members of the family Corvidae are available. Garvin (1996) sampled peripheral blood of blue jays (*Cyanocitta cristata* (Linnaeus, 1758)) from Highlands County and reported finding 27% of 539 birds positive for *H. danilewskii* and apparently no *H. picae*. In another sample of blue jays ($n = 15$) from Glades County, a single bird had *H. picae* present in blood films, and *H. danilewskii* was not detected at all (D. J. Forrester, University of Florida, and G. F. Bennett, Memorial University of Newfoundland, unpublished data). Four fish crow slides from Duval County were positive for both *H. picae* and *H. danilewskii* (Bishop and Bennett, 1990). M. G. Spalding, University of Florida (personal communication), identified *H. picae* in a blood film prepared at necropsy from a fish crow collected in Alachua County.

Trypanosoma avium has been found in many species of birds. This is the first record of this species in American crows from Florida and is a new host record for fish crows. *Trypanosoma ontarioensis* was first described from American crows (Woo and Bartlett, 1982) but has since been identified from a variety of avian species. In Florida, observations of trypanosome infections in members of the Corvidae are limited to *T. avium* from 2 of 539 blue jay blood films examined from Highlands County (Garvin, 1996).

Diagnosis of trypanosome infections by blood-film screening is believed to be a poor technique for observing true infection prevalence (Greiner, Bennett, Laird, and Herman, 1975), and therefore our prevalences may be underreported. Woo and Bartlett (1982) used a hematocrit centrifuge technique and found trypanosomes in 53% ($n = 121$) of American crows examined but did not compare these results with blood-film screening. Stabler et al. (1966) compared the prevalence of detection of *T. avium* in the blood and bone marrow of 139 species of birds. Twenty-nine of 677 birds had *T. avium* detected by blood-film examination, whereas 334 of the same birds were found to have infections of *T. avium* by examination of bone marrow. In only 4 individuals was *T. avium* detected by blood-film examination but not by bone marrow examination.

In this study, parasites of the genus *Plasmodium* were identified only in blood films from fish crows. All 6 infected birds had extremely low levels of parasitemia. No parasites were detected at the initial examinations of the blood films (10 min per film). Only a single parasite was detected on each of 3 blood films after approximately 20 min of study at $\times 400$ and approximately 20 min of study at $\times 1{,}000$. Only 2 of the observed parasites were schizonts of *Plasmodium* sp., 1 in each of 2 birds. The remaining 4 birds had gametocytes or developing gametocytes of consistent morphology, including displacement of the host cell nucleus towards the cell pole, to nonschizont *Plasmodium* sp. parasites in the 2 birds with schizonts. With the use of the key provided by Greiner, Bennett, White, and Coombs (1975), we believe this parasite is *P. relictum*. *Plasmodium relictum* has not been reported in fish crows prior to now. It has been reported from American crows (Coatney and West, 1938), but no published records exist for Florida. In southwestern Georgia, U.S.A., Love et al. (1953) found 1 of 15 American crows positive for *P. relictum* or *Plasmodium cathemerium* Hartmann, 1927. Scarvie and Clark (1971) identified *Plasmodium* sp. in 21% of American crows sampled, which accounted for 56% of the *Plasmodium* spp.-positive

American crows reported by Greiner, Bennett, Laird, and Herman (1975). No plasmodium parasites have been reported previously in members of the Corvidae from Florida.

The use of blood-film examination as a means to detect species of *Plasmodium* has limitations. The inoculation of blood from the species of concern to an uninfected susceptible species has been much more effective (Herman et al., 1966; Forrester et al., 1974). In both of these studies, no infections of *Plasmodium* spp. were diagnosed when blood films were examined. However, after inoculation of blood samples into their domestic counterparts, wild turkeys (*Meleagris gallopavo* Linnaeus, 1758) showed a prevalence of *Plasmodium* sp. of 75% (Forrester et al., 1974), and Canada geese (*Branta canadensis* Linnaeus, 1758) showed a prevalence of *Plasmodium* spp. of approximately 60% (Herman et al., 1966).

In our study, microfilariae were the most common parasite found in the blood of American crows (19%) but were detected in only 4% of fish crows. Microfilariae have been reported previously from both these species of crows. Greiner, Bennett, Laird, and Herman (1975) found microfilariae ''particularly prevalent'' in the Corvidae and also noted that blood-film diagnosis of this parasite is not the ideal method and may underestimate prevalence. Bartlett and Anderson (1980) identified 6 species of filarioid nematodes in American crows. In southwestern Georgia, U.S.A., American crows were commonly (>50%) infected with microfilariae, as were 2 of 4 fish crows (Robinson, 1954a, b).

We made no attempt to quantify levels of parasitemia within respective hosts. We report only on the prevalence of individual parasite species within two species of corvids. A number of host–parasite mechanisms as well as blood-film preparation techniques could affect parasitemia within a single host (Fedynich et al. 1995). Our samples consist of a single sample of birds from each species in which collection methods and study areas were different and separated in time by 24 yr. Within each species, collections were made only once at a random point in the host's life and the parasite's development within the host. We believe data derived from parasite intensity calculations in this study would be without merit.

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Research Note

Endohelminths from the Little Blue Heron *Egretta caerulea* from the Texas Gulf Coast

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ABSTRACT: Fourteen species of endohelminths, including 1 acanthocephalan, 3 cestodes, 1 nematode, and 9 trematodes, were collected from 13 little blue herons *Egretta caerulea* from the area of Galveston, Texas, U.S.A. A mean of 4.3 (3–6) species of endohelminths per host was found. Five species (3 cestodes and 2 trematodes) represent new host records. Comparison of results from this study with a similar survey by Sepúlveda et al. (1996) from Florida, U.S.A., suggests some hypotheses concerning possible roles of composition and complexity of trophic structures of these 2 regions in establishment of their respective endohelminth communities in little blue herons.

KEY WORDS: acanthocephalans, cestodes, nematodes, trematodes, *Egretta caerulea*, little blue heron, endohelminth communities, trophic structure, Gulf of Mexico, Texas.

The little blue heron *Egretta caerulea* (Linnaeus, 1758) is a small wading bird commonly found associated with inland waterways and coastal areas of North America, Central America, the Caribbean, and tropical South America (Walters, 1980). Despite its ubiquity, there have been relatively few reports of endohelminth parasites from this heron (Stiles and Hassall, 1894; Vevers, 1923; Travassos, 1930; Polk, 1941; Vigueras, 1944; Caballero and Hildalgo, 1955; Coil, 1955; Cable et al., 1960; Schmidt and Nieland, 1971, 1973), and no survey has been published from the Texas Gulf coast, U.S.A. Sepúlveda et al. (1996) provided a survey of parasitic helminths from 35 little blue herons in Florida, U.S.A., in which they reported 24 species of helminths, including 2 acanthocephalans, 8 nematodes, 13 trematodes, and unidentified cestode proglottids. The current study was intended to supplement existing reports of endohelminths from the little blue heron by providing intensi-

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Table 1. Prevalences and intensities of intestinal helminths from 13 little blue herons from Galveston, Texas, compared with data for 35 birds from southern Florida collected by Sepúlveda et al. (1996) (species of helminths found only in Florida are not listed).

Helminth*	USNPC no.	Prevalence (%)		Intensity			
				Mean		Range	
		F†	T‡	F	T	F	T
Acanthocephala							
Southwellina sp. (3)	90986	6	15	2	2	—	—
Cestoda							
Cyclustera capito (Rudolphi, 1819)§ (3)	90987	—	23	—	2	—	—
Dendrouterina ardeae (Rausch, 1955)§ (3)	90988	—	31	—	4	—	2–5
Dendrouterina papillifera (Fuhrmann, 1908)§ (3)	90989	—	38	—	4	—	1–11
Nematoda							
Tetrameres sp. (2)	90990	35	46	9	13	1–42	10–17
Trematoda							
Ascocotyle sp. (3, 4)	90991	—	23	—	19	—	18–21
Apharyngostrigea multiovata (Perez-Viqueras, 1944) (3)	90992	24	31	4	8	2–9	2–12
Apharyngostrigea simplex (Johnson, 1904) (4)	90993	6	23	1	13	—	7–17
Clinostomum complanatum (Rudolphi, 1814) (1)	90994	26	38	2	13	1–2	3–7
Diplostomum ardeae Dubois, 1969§ (3)	90995	—	23	—	5	—	3–6
Echinochasmus donaldsoni Beaver, 1941 (3)	90996	31	46	456	51	9–1,770	20–99
Phagiocola longa (Ransom 1920)§ (3, 4)	90997	—	23	—	17	—	7–23
Phagicola nana (Ransom, 1920) (3, 4)	90998	31	38	49	60	22–90	25–195
Posthodiplostomum macrocotyle Dubois, 1937 (3, 4)	90999	8	23	20	191	2-503	28–310

† F = Sepúlveda et al. (1996) from southern Florida.
‡ T = current study from Texas.
§ New host record.
* Numbers in parentheses indicate location in host birds from Texas: (1) oral cavity, (2) stomach, (3) small intestine, and (4) large intestine.

ties of infections and prevalences of helminths from this host along the Texas Gulf coast. We compare the current study from the Texas Gulf coast with the survey of Sepúlveda et al. (1996) from Florida. Intensity and prevalence follow the definitions given by Margolis et al. (1982).

Thirteen adult little blue herons were collected (U.S. Fish and Wildlife permit SCCL 691681 and Texas Parks and Wildlife permit SPR 0890272) from the intercoastal canal in the Galveston area of Texas (6 between December 1977 and November 1978, by shotgun; 4 in August 1992, salvaged specimens; and 3 in August 1995, salvaged specimens) and examined for parasitic helminths. Acanthocephalans, cestodes, and trematodes were relaxed in saline, fixed in alcohol-formalin-acetic acid (AFA), stained with Semichon's carmine, and mounted in Kleermount® or Canada balsam. Nematodes were fixed in warm 70% ethanol and stored in glycerin. A comparison of prevalences and intensities of helminths recovered in this study with those found by Sepúlveda et al. (1996) from Florida is given in Table 1. Representative specimens were deposited in the U.S. National Parasite Collection, Beltsville, Maryland (USNPC 90986–90999).

At least 3 of 14 species of endohelminths were found in all birds examined in Texas (100%). Infected birds each harbored a mean of 4.3 (3–6) helminth taxa. One acanthocephalan (*Southwellina* sp.), 3 cestodes (*Cyclustera capito, Dendrouterina ardeae*, and *Dendrouterina papillifera*), 1 nematode (*Tetrameres* sp.), and 9 trematodes (*Apharyngostrigea multiovata, Apharyngostrigea simplex, Ascocotyle* sp., *Clinostomum complanatum, Diplostomum ardeae, Echinochasmus donaldsoni, Phagicola longa, Phagicola nana*, and *Posthodiplostomum macrocotyle*) were found in Texas. The most prevalent species were *E. donaldsoni* (46%) and *Tetrameres* sp. (46%), followed by *C. complanatum* (38%), *D. papillifera*

(38%), *P. nana* (38%), *A. multiovata* (31%), and *Dendrouterina ardeae* (31%). Prevalences of all other helminth species ranged from 15% to 23%. Although all birds were collected in marine/estuarine habitats, the majority of species found in the current study were those that would likely have freshwater-based life cycles, with *P. longa*, *P. nana*, and possibly *Ascocotyle* sp. being probable saltwater species.

Differences in particular species composition, numbers of species of helminths present, and prevalences and intensities of helminth species found in comparing the current study with that of Sepúlveda et al. (1996) from Florida may be, at least in part, due to the smaller sample size of our study. Despite this difference, several observations suggest some hypotheses concerning the possible roles of the composition and complexity of the trophic structures of these 2 regions in establishment of their respective endohelminth communities. 1) In contrast to the survey of Sepúlveda et al. (1996), where 24 helminth taxa were found, only 14 species were found in the current study. The higher species richness of endohelminths found by Sepúlveda et al. (1996) could have been, in part, a factor of the more diverse ecosystem trophic structures present in Florida, which may have provided additional potential intermediate host species and thus increased the transmission of endohelminths to this definitive host. 2) The presence of the same 8 species of endohelminths in both Florida and Texas (1 acanthocephalan, *Southwellina* sp.; 1 nematode, *Tetrameres* sp.; and 6 trematodes, *A. multiovata, A. simplex, C. complanatum, E. donaldsoni, P. nana,* and *P. macrocotyle*) indicates that food chains that include the intermediate hosts necessary for completion of life cycles for these species were present in the trophic structures of both regions. 3) It is interesting to note that whereas the Florida study reported a large number of nematode species (7) and a small number of cestodes (unidentified proglottids), the Texas study found only 1 species of nematode and 3 species of cestodes. Five species (3 cestodes, *C. capito, Dendrouterina ardeae,* and *D. papillifera*; and 2 trematodes, *Diplostomum ardeae,* and *P. longa*) were found only in Texas and represent new host records, whereas 15 species (1 acanthocephalan, *Neoechinorhynchus* sp.; 8 nematodes, *Acuaria* sp., *Chandleronema* sp., *Contracaecum* spp., *Eustrongylides ignotus* Jaegerskiold, 1909, *Capillaria mergi* Madsen, 1945, *Syncuaria* sp., and *Tetrameres* sp.; and 6 trematodes, *Ascocotyle gemina* Font, Overstreet, and Heard, 1984, *Microphallus turgidus* (Leigh, 1958), *Phagicola diminuta* Stunkard and Haviland, 1924, *Pholeter anterouterus* Fischthal and Nasir, 1974, *Prosthogonimus ovatus* (Rudolphi, 1803), and *Ribeiroia ondatrae* (Price, 1931)) were found only in the Florida study. These observations suggest that some food chains may have been present in the Texas ecosystems sampled that were not present in the Florida ecosystems, and vice versa, thus providing for transmission of those species found only in one region. The absence of saltwater species, such as *Ascocotyle gemina, Contracaecum* spp., *Microphallus turgidus*, and *Phagicola diminuta* from Texas may be due to preferential feeding of little blue herons in fresh water, as indicated by the low number of saltwater species in these birds. 4) Although Florida birds had almost twice as many species of endohelminths as did Texas birds, the overall prevalence (100% in Texas compared with 94% in Florida) and mean number of taxa present (4.3 compared with 2.6) were greater in Texas. In addition, with the exception of intensities of *E. donaldsoni* (456 in Florida compared with 51 in Texas), endohelminth species reported in both of these studies generally had higher prevalences and intensities in Texas. *Echinochasmus donaldsoni* is a species that generally establishes high densities of metacercariae in a broad spectrum of second intermediate hosts, which may account for the higher intensities observed in Florida (Beaver, 1941). These observations suggest that having fewer food chains available and/or higher densities of intermediate hosts supporting these selected endohelminth species may have forced little blue herons in Texas to feed more frequently on a low number of species that served as intermediate hosts, thus concentrating fewer species of endohelminths in birds and resulting in the higher prevalences and intensities seen in Texas. The unidentified cestode proglottids found in the Florida study may represent at least 1 of the 3 species found in Texas. Specimens of *Ascocotyle* sp. were immature and could not be identified to species, but these specimens had longer ceca and a different pattern of the vitellaria compared with *Ascocotyle* sp. reported by Sepúlveda et al. (1996). *Southwellina* sp. and *Tetrameres* sp. could not be identified to species because of the poor quality of our specimens.

The establishment of endohelminth communities in little blue herons is undoubtedly a complex process in which age of birds, seasonal availability of food, diet shift of birds, extent of the areas sampled, and other factors may have contributed to some of the differences between our study and that of Sepúlveda et al. (1996). The possible role of trophic structure suggested above may provide some potential hypotheses that could be tested in future studies.

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Research Note

Endohelminth Parasites of the Trambollo *Labrisomus philippii* (Steindachner) (Osteichthyes: Labrisomidae) from the Central Peruvian Coast

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ABSTRACT: The endohelminth parasite fauna of the teleost fish *Labrisomus philippii,* the ''trambollo'' (Labrisomidae), from the central Peruvian coast is quantitatively described. The assemblage was composed of 7 species: the adult digeneans *Helicometra fasciata* (Rudolphi, 1819), *Zoogonus rubellus* (Olsson, 1868), *Prosorhynchus* Odhner, 1905 sp., and *Bucephalopsis* (Diesing, 1855) sp.; metacercariae of *Bucephalus* Baer, 1826, sp.; and the larval *Lacistorhynchus tenuis* (van Beneden, 1858) (Eucestoda) and *Corynosoma australe* Johnston, 1937 (Acanthocephala). Up to 98% of the fish were parasitized. The highest prevalence was shown by *Z. rubellus* (74%) and the highest mean intensity by *Bucephalopsis* sp. (103.7). No common pattern of infection as a function of host body size or sex was noted. The major characteristic of the endohelminth community of *L. philippii* was the richness of digeneans compared with those of other marine fishes in this geographical area. This richness may be a consequence of abiotic factors particular to the Peruvian Faunistic Province.

KEY WORDS: marine parasites, Digenea, Cestoda, Acanthocephala, ecology, *Labrisomus philippii,* fishes, Peru.

The ''trambollo'' *Labrisomus philippii* (Steindachner, 1866) is a bentho–littoral fish living off the Pacific coast of South America from Paita, Peru (05°10′S) to Coquimbo, Chile (29°55′S) (Chirichigno, 1998). The parasite fauna of *L. philippii*, like that of other littoral fishes in the Peruvian Faunistic Province (PFP), is poorly known. The only known metazoan parasites of *L. philippii* are the digeneans *Helicometra fasciata* (Rudolphi, 1819) (Opecoelidae) and *Sterrhurus* Looss, 1907, sp. (Hemiuridae), larval *Lacistorhynchus tenuis* (van Beneden, 1858) (Eucestoda), and larval *Corynosoma* Lühe, 1904, sp. (Palaeoacanthocephala) (Luque et al., 1991; Luque and Oliva, 1993).

As a rule, the metazoan parasite communities of marine fishes in the PFP are sparse, mainly because of the low richness of trophically transmitted helminths (Luque and Oliva, 1999), which may be caused by local abiotic environmental factors. The PFP includes the central and southern Peruvian coast and the northern and central Chilean coast, with a southern boundary at ca. 30°S (Brattström and Johanssen, 1983). It is characterized by oceanographic processes such as upwelling and the El Niño Southern Oscillation (Luque and Oliva, 1999). Some hypotheses have been proposed to explain this phenomenon, such as poor benthic and pelagic communities and the narrowness of the continental shelf (Oliva et al., 1996; Oliva and Luque, 1998; Oliva, 1999). These conclusions have been drawn from studies of the parasite communities of benthic and pelagic fishes but not bentho–littoral fishes such as *L. philippii*. Herein, we explore the qualitative and quantitative characteristics of the endohelminth fauna of a bentho–littoral fish population, in order to verify whether its parasite community follows the same pattern observed in benthic and pelagic fishes.

We studied a sample of 100 specimens of *L. philippii* caught by local fishermen between February and May 1988 near Chorrillos, Peru (12°30′S). For each fish, total length (to nearest 0.5 cm) and sex were determined. Parasitological analysis included total necropsy of each fish host, and each gut was separately dissected and examined under a stereomicroscope. Parasites were fixed, preserved, and stained according to

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Table 1. Endohelminths of *Labrisomus philippii* from Chorrillos, Peru: ecological descriptors.*

Species	PR	CI	Mi ± SD	MaxI
Helicometra fasciata	13	6.7	2.4 ± 1.4	5
Zoogonus rubellus	74	8.6	28.7 ± 60.4	385
Prosorhynchus sp.	19	7.7	5.2 ± 8.5	34
Bucephalopsis sp.	37	9.3	103.7 ± 229.3	1,300
Bucephalus sp.†	2	2.7	4.0 ± 4.2	7
Lacistorhynchus tenuis	39	9.6	4.6 ± 7.2	36
Corynosoma australe	22	8.1	1.7 ± 1.5	7

* PR = prevalence of infection; CI = confidence interval (95%); Mi = mean intensity of infection; MaxI = maximum intensity of infection.

† Metacercariae, only 2 fish infected with 1 and 7 metacercariae.

traditional techniques (Pritchard and Kruse, 1982). Ecological descriptors follow Bush et al. (1997). Univariate analysis of transformed intensity data (log $n + 1$) and prevalence data was performed in order to evaluate the role of host sex and length on the quantitative characteristics of the infection. Statistical analysis followed Zar (1996), and SYSTAT® (Wilkinson, 1990) was used as the statistical tool.

Ninety-eight percent of the sample was infected by 1 or more parasite species (mean 3.1, SD = 1.56). A total of 6,120 individuals belonging to 7 species was obtained. Table 1 lists the metazoan parasites found and their ecological descriptors. All the parasite species except *H. fasciata* were overdispersed. The highest intensity was shown by the digenean *Bucephalopsis* sp., with 1,300 specimens in a 23-cm-long female. Mean lengths of male (20.4 cm, SD = 3.36, $n = 48$) and female fish (20.6 cm, SD = 2.48, $n = 52$) did not differ significantly ($F_{1,98} = 0.041$, $P = 0.84$).

Table 2 shows ecological descriptors for male and female hosts. Sex seemed to affect prevalence of infection only for the digenean *H. fasciata* (higher in males) and *Bucephalopsis* sp. and *C. australe* (higher in females). Mean intensity of infection differed significantly only for *L. tenuis* (higher in females). A relationship between prevalence and host length was evident only for *H. fasciata* and *L. tenuis.* Mean intensity of infection was associated with host length only for the digenean *Z. rubellus* (Table 3).

Sex may be important when different energy requirements or different feeding habits are expected for males and females because of their different physiology (González and Acuña, 2000). Parasites would be more accessible to individuals of the sex with a higher nutritional requirement (Riffo and George-Nascimento, 1992).

Host body size (as an expression of age) and sex are factors that may explain the qualitative and quantitative characteristics of the parasitic communities in marine fishes. Because nutritional requirements are greater in older (larger) individuals than in smaller ones, an increased parasite burden is expected for larger fish. Because adult endohelminths in the digestive tract are considered to have short life spans (Speare, 1995), increased intensity occurs when the infection rate is higher than parasite mortality (Oliva and Guerra, 1987); but larval stages encysted in different tissues, the celomic cavity, or muscle simply accumulate in the host. According to our data, the prevalence of infection of *H. fasciata* and *L. tenuis* and the intensity of infection of *Z. rubellus* were positively and significantly correlated with length of the host.

In contrast to other marine fishes of the PFP (Oliva et al., 1996; González and Acuña, 1998; Oliva and Luque, 1998; Oliva, 1999), the en-

Table 2. Endohelminths of *Labrisomus philippii* from Chorrillos, Peru: prevalence (PR) and mean intensity of infection (MI) for male and female fish.

	PR				MI			
Species	♂	♀	*G**	*P*	♂	♀	*F**	*P*
Helicometra fasciata	20.8	5.8	5.2	0.023	2.1	3.3	0.44	0.51
Zoogonus rubellus	72.9	59.6	1.9	0.13	19.6	36.7	2.98	0.09
Prosorhynchus sp.	12.5	25.0	2.6	0.11	4.5	5.5	0.4	0.54
Bucephalopsis sp.	25.0	48.0	5.8	0.018	80.6	111.0	0.97	0.33
Lacistorhynchus tenuis	45.8	36.7	1.8	0.19	2.5	7.2	4.7	0.04
Corynosoma australe	8.3	34.6	10.7	0.002	1.35	1.8	0.44	0.51

* G = value of the G-test; F = value of F in ANOVA test.

Table 3. Endohelminths of *Labrisomus philippii* from Chorrillos, Peru: prevalence (PR) and intensity of infection (I) as a function of host body length.

Species	PR		I		
	r	*P**	*r*	*n*	*P*
Helicometra fasciata	0.91	<0.02	0.21	13	>0.2
Zoogonus rubellus	0.63	>0.05	0.26	74	<0.05
Prosorhynchus sp.	0.61	>0.10	0.15	19	>0.5
Bucephalopsis sp.	0.58	>0.10	0.08	37	>0.5
Lacistorhynchus tenuis	0.79	<0.02	0.10	39	>0.5
Corynosoma australe	0.52	>0.10	0.17	22	>0.2

* Sample size equals 6 for all relationships.

dohelminth fauna of *L. philippii* was characterized by the richness of digeneans, i.e., 5 species, 4 of them adult forms. Recently, González and Acuña (2000) also found a high richness of endohelminths in the near-bottom-feeding rockfish *Sebastes capensis* (Gmelin, 1788). They reported 9 endohelminth species, 5 of them digeneans. According to Rohde (1993), and since the review of Polyanski (1961), the role of habitat and diet in the determination of characteristics of the parasite fauna of marine fishes is clear. The availability of infective stages for trophically transmitted parasites (TTP), such as digeneans and acanthocephalans, depends mainly on the presence of a suitable intermediate host for these parasites, and the availability of such hosts will be, in turn, a function of a favorable environment. In digeneans, the life cycle includes the release of cercariae from the first intermediate host, a mollusk (Poulin, 1998). Thus digenean richness will depend on the availability of such intermediate hosts in the environment. Environmental conditions dramatically affect the structure of parasite communities of fishes, both ectoparasites and endoparasites, as demonstrated by Halmetoja et al. (2000). Such an effect is directly associated with the presence of adequate intermediate hosts for parasites, at least for TTP. The only known information on the diet of *L. philippii* from the PFP was given by Velez (1981), who analyzed specimens of trambollo caught at depths of 1–6 m off Iquique, northern Chile. The diet was composed mainly of benthic invertebrates (24 species of mollusks, 27 crustaceans, 2 echinoderms, and 1 polychaete). As pointed out by Jackson et al. (1997), life cycles of marine parasites remain poorly understood because of the intrinsic difficulty in studying them. Currently, no published information is available about the life cycle of marine parasites, such as digeneans, in the PFP, but the role of mollusks and other invertebrates such as crustaceans as intermediate hosts for digeneans is well known. The high diversity of mollusks and crustaceans in the diet of *L. philippii* may explain the comparative richness of digeneans in this fish host. Cribb et al. (1994) found greater digenean diversity in fishes with a broad diet of small invertebrates and vertebrates.

The sparse endohelminth fauna (mainly digeneans) of marine fishes in the PFP has been explained mainly by oceanographic processes such as the El Niño Southern Oscillation, and upwelling (Oliva and Luque, 1998), which lead to a highly productive area but a short food chain. Pelagic productivity in this area apparently is supported only by euphausiids and the Peruvian anchovy *Engraulis ringens* Jennyns, 1842 (Alheit and Bernal, 1993). Recently, Oliva (1999) suggested that the narrowness of the continental shelf may affect the scarcity of digeneans because of the relatively limited habitat for mollusks, their first intermediate host. In Chile, the shelf is rather narrow and the 200-m isobath is found within 20 km from the coastline and within 40 km off Callao, Peru (Oliva, 1999). A factor not yet explored but suggested by Campbell (1983) is the presence of hypoxic sediments because of the particular oceanographic characteristics of the area affected by the Humboldt Current. These conditions limit benthic fauna, including potential mollusk and crustacean intermediate hosts for digeneans and acanthocephalans, because of the hypoxic conditions present deeper than 40 m (Arntz and Fahrbach, 1996). The metazoan parasites of fish living deeper than 40 m in the PFP are known only for the flatfish *Hippoglossina macrops* (Steindachner, 1876). González et al. (2001) studied 123 specimens of this flatfish caught in the vicinity of Coquimbo, Chile (30°S), between 160 to 320 m, and found only 1 species of digenean (an unidentified hemiurid) with a low prevalence of infection (1.6%). The relatively high richness of digeneans in *L. philippii* compared with other fishes from the PFP can be explained by the habitat occupied by this fish species. *Labrisomus philippii* is associated with rocky shores in shallow waters less than 20 m deep (Mann, 1954), which remain relatively well oxygenated (Arntz and Fahrbach, 1996). A similar picture is evident for *Sebastes capensis*, parasitized by 5 species of digeneans (González and Acuña, 2000). *Sebastes capensis* is caught by local fishermen at depths of 30–60 m in Coquimbo, and according to Antezana-Jerez (1978), hypoxic conditions occur below 100 m in this area. Both *S. capensis* and *L. philippii* are associated with well-oxygenated waters where mollusks and crustaceans remain abundant, serving as intermediate hosts for digeneans.

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Research Note

Larval Tapeworms (Cestoda: Dilepididae) from the Mummichog *Fundulus heteroclitus* (Linnaeus, 1766) and Striped Killifish *Fundulus majalis* (Walbaum, 1792) from South Carolina, U.S.A.

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Abstract: Larval stages (metacestodes) of 2 dilepidid tapeworms (Eucestoda: Cyclophyllidea) are reported from the mesenteries and liver of the mummichog *Fundulus heteroclitus* and striped killifish *Fundulus majalis* from South Carolina, U.S.A. *Cyclustera ibisae* (Schmidt and Bush, 1972) is reported for the first time from a fish intermediate host, whereas metacestodes of *Glossocercus caribaensis* (Rysavy and Macko, 1973) (syn. *Parvitaenia heardi* Schmidt and Courtney, 1973) have only recently been found in fish from southeastern Mexico (Yucatan).

Key words: metacestodes, Dilepididae, Cestoda, *Glossocercus caribaensis, Cyclustera ibisae, Fundulus heteroclitus, Fundulus majalis,* U.S.A.

Larval stages (metacestodes) of dilepidid tapeworms occur in freshwater and brackish-water fishes, and their adult stages are found in fish-eating birds, such as herons and cormorants (Bona, 1975, 1994). Some dilepidid larvae, such as *Valipora campylancristrota* (Wedl, 1855) from the gall bladder of cyprinids and other fishes in the Palaearctic Region (Bona, 1975), are relatively common, but data from North America are very scarce. Hoffman (1999) reported only 3 species of dilepidids from freshwater fishes in North America. In addition, Chandler (1935) found larvae of 2 dilepidids in the mesenteries of the sheepshead minnow *Cyprinodon variegatus* Lacépède, 1803, and the Atlantic silverside *Menidia menidia* (Linnaeus, 1766) from Galveston Bay, Texas, U.S.A., and described them as *Glossocercus cyprinodontis* Chandler, 1935, and *Cysticercoides menidiae* Chandler, 1935, respectively. The latter species has been shown by Scholz (2001) to be conspecific with *Ascodilepis transfuga* (Krabbe, 1869).

Dilepidid metacestodes may be much more frequent in North American fishes than previously thought. Scholz and Salgado-Maldonado (2001) found as many as 13 species in freshwater and coastal fishes from central and southeastern Mexico. During the present study of the parasites of fishes from a saltwater estuary near Georgetown, South Carolina, U.S.A., encysted

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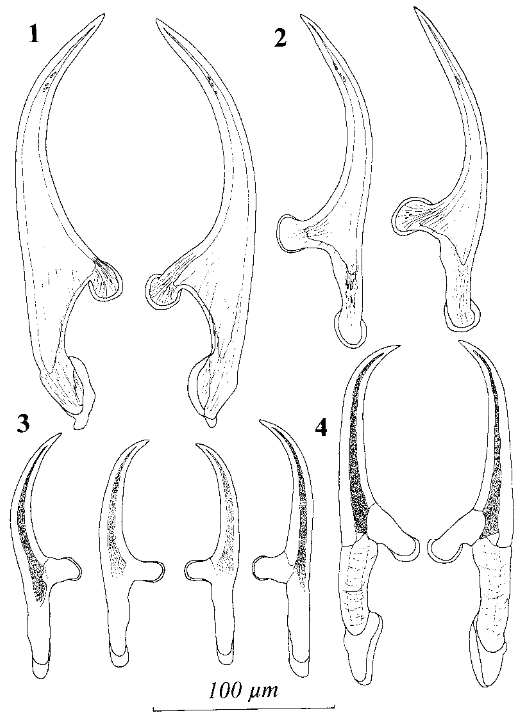
cyclophyllidean larvae were found attached to the mesenteries and in the liver of the mummichog *Fundulus heteroclitus* (Linnaeus, 1766) and striped killifish *Fundulus majalis* (Walbaum, 1792) (Cyprinodontidae).

A total of 205 mummichog (109 males, 40–100 mm [mean 63 mm] long, and 96 females, 40–94 mm [65 mm] long) were collected with a baited minnow trap in North Inlet—Winyah Bay National Estuarine Research Reserve, located approximately 10 km east of Georgetown, South Carolina, in August 2000. A total of 50 striped killifish (23 males, 43–94 mm [61 mm] long, and 27 females, 62–119 mm [89 mm] long) were collected at the same site by seine in May 2001. The fish were transported alive in aerated containers to the laboratory at Converse College and kept alive in aerated artificial salt water until the body cavity and internal organs (liver) were examined for parasites with a dissecting microscope.

Cestode larvae were fixed with alcohol–formalin–acetic acid (AFA); some larvae were flattened under pressure. The specimens studied were stained with Semichon's acetocarmine, dehydrated, and mounted as permanent preparations in Canada balsam. Illustrations were made with a drawing tube on an Olympus BH-2® microscope.

The cestode larvae were enclosed individually or in groups in a cyst, and they were very active when released from the cyst wall. Examination showed that they belong to 2 species; the morphologies of both are described below.



Figures 1–4. 1, 2. *Cyclustera ibisae* (Schmidt and Bush, 1972) from mummichog. 1. Large (distal) hooks. 2. Small (proximal) hooks. 3, 4. *Glossocercus caribaensis* (Rysavy and Macko, 1973) from mummichog. 3. Small (proximal) hooks. 4. Large (distal) hooks.

Cyclustera ibisae (Schmidt and Bush, 1972) Bona, 1975 (Synonyms *Parvitaenia ibisae* Schmidt and Bush, 1972; *Parvitaenia eudocimi* Rysavy and Macko, 1973) (Figs. 1, 2)

DESCRIPTION: Based on 30 specimens from *F. heteroclitus*. Metacestodes encysted; cysts oval to almost spherical, 864–1,380 × 784–1,220, with scolex invaginated. If scolex everted (n = 7), neck (stalk) 592–1,136 long; scolex 464–752 × 448–560, with 4 oval suckers, 147–179 × 128–166. Rostellar apparatus large, conical, 410–493 × 186–256; rostellum bearing 20 hooks arranged in 2 circles; handle and guard striated lengthwise. Large (distal) hooks 221–240 long (n = 15), with long, gently curved blade, almost straight handle, and posteriorly directed guard (Fig. 1; measurements of hooks in Table 1). Small (proximal) hooks 175–194 long (n = 19), with slightly curved blade, straight handle, and massive, perpendicularly directed guard (Fig. 2).

DEPOSITION OF SPECIMENS: Seventeen specimens and numerous unmounted larvae from *F. heteroclitus* in a vial and 1 specimen from *F. majalis* in The Natural History Museum, London, U.K. (Collection Nos. 2001.2.7.1–43 and 2001.11.15.2); 10 specimens from *F. heteroclitus* and 1 specimen from *F. majalis* in the U.S. National Parasite Collection, Beltsville, Maryland, U.S.A. (Collection Nos. 91522 and 91733); 3 specimens from *F. heteroclitus* and 1 specimen from *F. majalis* in the helminthological collection of the Institute of Parasitology, AS CR, České Budějovice, Czech Republic (Collection No. C-337).

INFECTION RATE: Metacestodes of *C. ibisae* were found in 5 males of striped killifish (prevalence 22%); intensity of infection ranged from

Table 1. Measurements of hooks of *Cyclustera ibisae* (total length of hooks in bold).

Authors:	Schmidt and Bush (1972)	Scholz et al. (2002)	Bona (1975)	Present data	
				Fundulus heteroclitus	*Fundulus majalis*
Hosts:	Birds	Birds	Birds		
Country:	U.S.A.	Mexico	U.S.A., Cuba	U.S.A.	U.S.A.
Large hooks	**225–240**	**227–243**	**221–239**	**221–240**	**222–237**
Blade	"Long"	160–176	140–167	141–160	147-157
Handle	"Short"	77–96	78–86	77–86	74–76
Blade/handle ratio	—	1.76–2.20	—	1.73–1.98	2.00–2.09
Small hooks	**170–204**	**179–198**	**178–192**	**173–194**	**173–192**
Blade	"Long"	128–141	118–126	112–125	112–128
Handle	"Short"	70–86	69–78	72–80	68–70
Blade/handle ratio	—	1.56–1.83	—	1.45–1.73	1.59–1.82

1 to 22 (mean 9). Because the precise number of individual larvae of each cestode species in mummichogs was not counted, the values of prevalence and mean intensity are not available. A total of 151 mummichogs (75 males and 76 females, i.e., prevalence 74% with values of 70% in males and 78% in females) were infected with 1–49 metacestodes of *C. ibisae* and *G. caribaensis* (mean intensity 8; males mean 10 [range 1–49]; females 7 [range 1–32]).

COMMENTS: The metacestodes are apparently conspecific with *C. ibisae,* described as *P. ibisae,* from the intestine of the white ibis *Eudocimus albus* (Linnaeus, 1758) (Ciconiiformes: Threskiornithidae) from Payner Prairie, Alachua County, Florida, U.S.A. (Schmidt and Bush, 1972). Adults of *C. ibisae* have been found in fish-eating birds such as ibises, spoonbills, herons, pelicans, cormorants, ospreys, and common loons in the southeastern U.S.A. (Florida, Georgia), Cuba, and southeastern Mexico (Yucatan Peninsula) (Schmidt and Bush, 1972; Rysavy and Macko, 1973; Bona, 1975; Sepúlveda et al., 1994, 1999; Kinsella et al., 1996; Kinsella and Forrester, 1999; Scholz et al., 2002). Our material represents the first record of metacestodes of *C. ibisae* from fish intermediate hosts.

Glossocercus caribaensis (Rysavy and Macko, 1973) (Synonyms *Parvitaenia caribaensis* Rysavy and Macko, 1973; *Parvitaenia heardi* Schmidt and Courtney, 1973) (Figs. 3, 4)

DESCRIPTION: Based on 3 specimens from *F. heteroclitus.* Metacestodes encysted, with scolex invaginated; cysts elongate, 2,430–2,960 × 528–608. Scolex 435–480 × 352–390; neck region (stalk) 320–768 long. Scolex with 4 oval suckers, 134–208 × 109–138. Rostellar apparatus ovate, 214–282 × 131–198; rostellum armed with 2 circles of 10 massive hooks each. Hooks, especially

Table 2. Measurements of hooks of *Glossocercus caribaensis* (total length of hooks in bold).

Authors:	Rysavy and Macko (1973)	Schmidt and Courtney (1973)	Scholz and Salgado-Maldonado (2001)	Present data	
Country:	Cuba	U.S.A.	Mexico	U.S.A.	U.S.A.
				Fundulus heteroclitus	*Fundulus majalis*
Hosts:	Birds	Birds	Fish		
Large hooks	**215**	**200–210**	**189–211**	**186–205**	**184–205**
Blade	—	—	106–128	113–126	117–125
Handle	—	—	74–88	77–82	72–83
Blade/handle ratio	—	—	1.20–1.61	1.42–1.61	1.42–1.73
Small hooks	**143–151**	**140–150**	**134–146**	**124–143**	**133–143**
Blade	—	—	66–82	68–82	72–83
Handle	—	—	62–75	56–66	62–68
Blade/handle ratio	—	—	1.15–1.23	1.18–1.28	1.09–1.29

larger ones, with massive sclerification in handle and guard (epiphyseal thickenings) and rugose area within blade (Figs. 3, 4). Large (distal) hooks 186–205 long (n = 9), with blade almost straight except for curved distal tip, nearly straight handle, and long, massive guard, directed posteriorly (Fig. 4). Small (proximal) hooks 124–143 long (n = 10; Table 2), with blade more curved than in distal hooks, almost straight handle, and guard directed perpendicularly (Fig. 3, Table 2).

DEPOSITION OF SPECIMENS: Two specimens from *F. heteroclitus* and 3 specimens from *F. majalis* in The Natural History Museum, London, U.K. (Collection Nos. 2001.2.7.4–43 and 2001.11.15.1); 1 specimen from *F. heteroclitus* and 6 specimens from *F. majalis* in the U.S. National Parasite Collection, Beltsville, Maryland, U.S.A. (Collection Nos. 91523 and 91732); and 1 specimen from *F. majalis* in the helminthological collection of the Institute of Parasitology, ASCR, České Budějovice, Czech Republic (Collection No. C-282).

INFECTION RATE: A total of 29 striped killifish (13 males and 16 females, i.e., prevalence 58% with values of 57% in males and 59% in females) were infected with 1–38 metacestodes of *G. caribaensis* (overall mean intensity 5; mean of males 6 [range 1–38], of females 4 [range 1–21]). Data on mummichog infection as indicated above.

COMMENTS: The metacestodes possess hooks of identical shape to those of *G. caribaensis* (see Rysavy and Macko, 1973; Scholz and Salgado-Maldonado, 2001). This species was described from the great blue heron *Ardea herodias* Linnaeus, 1758, as *P. caribaensis* by Rysavy and Macko (1973) from Cuba and, later in the same year, as *P. heardi* from the same bird host in South Carolina by Schmidt and Courtney (1973). Hooks, especially smaller (proximal) hooks, of some larvae from mummichogs are shorter than those of adults (see Table 2), but this difference is due to incomplete growth of an amorphous part of the hooks in the fish intermediate host (see Scholz and Salgado-Maldonado, 2001; Table 2).

Metacestodes of *G. caribaensis* were found first in the mesenteries and liver of *Fundulus persimilis* Miller, 1955, *Fundulus grandissimus* Hubbs, 1936 (Cyprinodontidae), and the Mexican mojarra *Cichlasoma urophthalmus* (Günther, 1862) (Cichlidae) from coastal lagoons on the northern coast of the Yucatan Peninsula, Mexico (Scholz and Salgado-Maldonado, 2001). These authors noted that a metacestode of *G. caribaensis*, from the mesenteries of *F. heteroclitus* from Galveston Bay, Texas, U.S.A. (U.S. National Parasite Collection, Beltsville, Maryland, No. 80404), was misidentified by Chandler (1935) as *G. cyprinodontis.*

The present specimens confirm the occurrence of metacestodes of *G. caribaensis* in the mummichog in the U.S.A. Mummichogs, striped killifish, and other cyprinodontids of the genus *Fundulus* Lacépède, 1803, seem to be the most suitable fish hosts of this parasite, which has been recorded only from the southeastern U.S.A, Mexico, and Cuba (Rysavy and Macko, 1973; Schmidt and Courtney, 1973; Sepúlveda et al., 1999; Scholz and Salgado-Maldonado, 2001).

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Research Note

An Accacoeliid Metacercaria Parasitizing the Arrow Worm *Flaccisagitta enflata* (Grassi, 1881) from the Mexican Caribbean Sea

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ABSTRACT: Trematode larvae of the family Accacoeliidae were obtained from *Flaccisagitta enflata* collected in the Mexican Caribbean Sea during February, March, May, and August 1991. Two parasites were found in the coeloms of 2 chaetognaths of 14,583 examined (prevalence = 0.014%; intensity = 1). The parasites have 5 or 6 branches on each side of the anterior intestinal ceca and 2 deeply stained zones, 1 internal on the posterior edge of the acetabulum and the other a glandular structure around the cloacal pore in the posterior part of the body. Two tegumental folds are present on the anterior and posterior parts of the parasite. These trematode larvae, their host, and their occurrence in the Mexican Caribbean Sea are reported for the first time.

KEY WORDS: Accacoeliidae, metacercaria, chaetognaths, *Flaccisagitta enflata,* arrow worm, Caribbean Sea, Mexico.

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Studies of parasitism in the planktonic realm have been conducted mostly in the cold-temperate waters of Europe (Dollfus, 1960; Theodorides, 1989) and in the tropical oceans of Africa (Dollfus, 1960), India (Dollfus et al., 1954; Furnestin and Rebecq, 1966; Madhavi, 1968), and some areas of the Florida coast and the Caribbean Sea (Hutton, 1952, 1954; Suárez-Caabro, 1955; Dawes, 1958, 1959). Only 3 previous studies addressed parasitism in the plankton community in the Mexican Caribbean Sea (Gómez del Prado-Rosas et al., 1999a, b, 2000). In these studies, several chaetognath species were reported harboring metacercariae with an H-shaped intestine. The new trematode larvae reported and described herein with prevalence and intensity data were found in a nonencysted stage and belong to the family Accacoeliidae. The chaetognath *Flaccisagitta* (formerly *Sagitta*) *enflata* (Grassi, 1881) is reported as a new host and the Mexican Caribbean Sea as a new locality for this parasite.

Zooplankton samples were obtained in the Mexican Caribbean Sea in February, March, May, and August 1991 at 22 stations for each sampling month. Samples were collected to carry out studies on the composition, abundance, and distribution of the major zooplankton groups (Gasca et al., 1996). Sampling was done by near-surface oblique tows (0–50 m depth) with a square-mouth net (0.45 m per side) with a digital flowmeter attached to the mouth. Samples were immediately fixed in buffered (calcium carbonate) 4% formaldehyde–seawater. Chaetognaths, frequently the second most abundant zooplankters after copepods (Øresland, 1994), were one of the groups analyzed. All chaetognaths were counted and identified to species with a stereomicroscope, and those containing parasites were prepared for further study. Hosts and parasites were stained with Harris' hematoxylin and acetic carmine, cleared in methyl salicylate, and mounted in synthetic resin. Prevalence and intensity of infection were calculated according to Margolis et al. (1982). Measurements are given in millimeters with the means in parentheses. Although 2 specimens were found, only 1 drawing, made with a camera lucida, is provided.

A total of 14,583 *F. enflata* specimens comprising about 60% of the total chaetognaths collected were studied during the 4 sampling periods (Gasca et al., 1996). *Flaccisagitta enflata* was the only species parasitized by the metacercaria reported here. The prevalence of parasitism was 0.014% and the infection intensity was 1.

DESCRIPTION: Based on 2 specimens. Body small, elongate, spineless, nearly twice as long as wide, with both ends rounded and posterior part slightly wider. Total length 0.522–0.622 (0.572), width 0.280–0.330 (0.300). Tegument of forebody sparsely papillated. Two tegumental folds present, 1 located on anterior part of body and 1 on posterior end. Oral sucker 0.009 to 0.010 (0.095), rounded, subterminal, muscular, bearing 4 to 5 papillae on its lower internal edge. Acetabulum in middle third of body, prominent, strongly muscular, elongated, 0.200–0.215 (0.207) by 0.140–0.160 (0.150), with thin crenulated membrane. Heavily stained glandular area

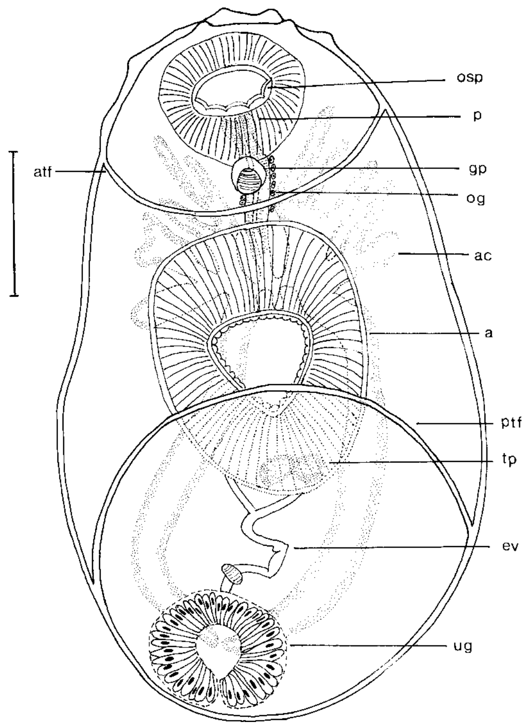

Figure 1. Accacoeliid metacercaria (ventral view) from the arrow worm *Flaccisagitta enflata* from the Mexican Caribbean Sea. a = acetabulum; ac = anterior ceca; atf = anterior tegumental fold; ev = excretory vesicle; gp = genital papilla; og = esophagus glands; osp = oral sucker papillae; p = pharynx; ptf = posterior tegumental fold; tp = testicular primordia; ug = uroproct, showing the heavily stained glandular structure. Scale 0.1 mm.

present, surrounding the cloacal pore on its internal edge. Sucker ratio 1:2.1.

Pharynx oval, muscular, 0.049–0.056 (0.052) by 0.015–0.018 (0.016). Esophagus enlarged, with cecal bifurcation preacetabular or acetabular, depending on degree of contraction. Glandular cells few, small, lateral to esophagus. Intestinal ceca H-shaped, anterior limb with 5 or 6 enlarged diverticula on each side; posterior ceca not diverticulated, ending in excretory vesicle, forming an uroproct. Testicular primordia postacetabular, arranged opposite or in tandem. Ventral genital papilla located between oral sucker and anterior cuticular fold. Excretory vesicle Y-shaped. Uroproct and cloacal pore surrounded by conspicuous heavily stained glandular structure (Fig. 1).

HOST: *Flaccisagitta enflata* (Grassi, 1881).

SITE OF INFECTION: Coelom.

LOCALITY: Mexican Caribbean Sea (18°39′41″N; 87°33′00″W).

SPECIMENS DEPOSITED: One in the Colección Nacional de Helmintos, Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City, catalog number CNHE-3310; the other in the Colección Parasitológica, Museo de Historia Natural, Universidad Autónoma de Baja California Sur, Mexico, catalog number 221.

The accacoeliid larvae reported in this study share some similarities with those previously reported from several chaetognath species, particularly with respect to the H-shaped intestine and the uroproct. Dollfus et al. (1954) suggested that the trematodes in this family parasitizing *F. enflata* from the Madras coast of India were possibly a species of the genera *Accacladium* Odhner, 1928, or *Tetrochetus* Looss, 1912. Later, Dollfus (1960) recorded metacercariae in the chaetognath *Flaccisagitta hexaptera* (d′Orbigny, 1843) from the Azores Islands and indicated that the parasites resembled those reported in 1954 from India. Yamaguti (1971), however, suggested that these larvae belong to the genus *Orophocotyle* (Yamaguti, 1958) because of the shape of the acetabulum and the presence of small wart-like papillae.

The metacercaria found in Villefranche, France (Dollfus, 1960), has at the posterior end "a clearly delimited intensely stained annular mass, in the form of an invagination at terminal end." This characteristic is not shared with the specimens from the Caribbean.

Regarding metacercariae collected in the Bay of Algiers, Dollfus (1960) thought these larvae most probably belonged to the genus *Accacladocoelium* Odhner, 1928, because of the 3 short dorso-ventrally directed cecal diverticula and an accessory sucker on the acetabulum.

Cercaria owreae (Hutton, 1954) has 6 small diverticula on its anterior ceca and also has posterior appendages. The latter structures are not present in the 2 specimens from the Caribbean. Furthermore, anterior and posterior ventral tegumental folds in the specimens from the Mexican Caribbean Sea are unique and have not been reported in any of the metacercariae mentioned above or in any adult species of the family Accacoeliidae sensu Yamaguti (1971).

Concerning the characteristics of the intestinal ceca, if these structures do not undergo major modifications when the larvae become adults, then the genera having diverticula in the anterior branches of the intestine are either *Accacladocoelium* or *Guschanskiana* Skrjabin, 1959. The specimens from the Caribbean Sea, however, do not belong to *Accacladocoelium* because they have neither ventral nor dorsal diverticula in the posterior branches of the intestine nor a regularly or densely papillated tegument on the forebody.

These larvae cannot belong to *Guschanskiana* because the posterior cecum is not diverticulated, and they lack the densely papillated tegument on the posterior end present in *Guschanskiana*. Of the remaining genera of the family, the specimens reported here do not belong to *Accacoelium* Monticelli, 1893, because the anterior ceca are diverticulated and the tegument is sparsely papillated on the forebody. Neither are they in *Tetrochetus* Looss, 1912, because they lack an esophageal bifurcation and because of the anteriorly diverticulated cecum. Finally, they do not belong to any of the genera of the subfamily Orophocotylinae because they lack the muscular accessory lobes (small wart-like papillae) on the acetabulum.

These features, together with the 5 or 6 diverticula in the anterior cecum of the intestine and the 2 densely stained zones, 1 on the lower internal edge of the acetabulum and the other around the cloacal pore, are distinctive features of the parasites from the Mexican Caribbean Sea. Further studies, particularly of the adult stage, are needed to clarify their systematic position.

On the other hand, the variability in the testicle primordia of the metacercariae from the Mexican Caribbean Sea seems to be related to the sampling and fixation method rather than to morphological variation of the specimens, as reported in *Posthodiplostomum minimum* (MacCallum, 1921), a strigeoid trematode from the intestine of piscivorous birds, by Palmieri (1976, 1977a, b, c) and Pérez-Ponce de León (1995).

The low prevalence of trematode larvae reported here is similar to previous reports of other trematode larvae parasitizing chaetognaths. Dollfus et al. (1954) recorded 1% to 3% accacoeliid metacercariae and 1 to 4 individual accacoeliid larvae in each of several species of chaetognaths (Dollfus, 1960). In *C. owreae*, Hutton (1954) reported prevalences of 0.09%, 0.14%, and 1.15%; Dawes (1959) reported 7%; Furnestin and Rebecq (1966) reported prevalences of 0.07% to 1.05%; and Gómez del Prado et al. (1999b) reported 0.11%. Gómez del Prado et al. (1999a) reported a prevalence of 0.004% for a didymozoid larva parasitizing the chaetognath *Serratosagitta serratodentata* (Krohn, 1853).

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